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A Report of A Preliminary Corrosion Survey at the Proposed Northern California Youth Center

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16. ABSTRACT

On July 6, 1962, Mr. Aldo Crestetto, Civil Engineer Supervisor, Division of Architecture, requested by letter that the Materials and Research Department perform a soil resistivity survey at the proposed site of the Northern California Youth Center located near Stockton, San Joaquin County, California.

It was requested that a corrosion survey be made for the purpose of protecting future underground utility installations from accelerated corrosion at the proposed building site.

Representatives of the Materials and Research Department performed the preliminary corrosion survey on July 24 and 25, 1962, and the results are included in this report.

Corrosive soils were found at the proposed site. It is estimated from an empirical corrosion test that a bare 3/4" steel pipe could be perforated by corrosion in the low resistivity soils in approximately five years.

The electrical resistivity of the soils at this site indicates that it is highly corrosive to underground steel pipe; therefore, it is recommended that cathodic protection be applied to any underground steel pipe.

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STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

A REPORT OF

A PRELIMINARY CORROSION SURVEY

AT THE PRO[illegible] CENTER

62-21

September 1962

MATERIALS & RESEARCH DEPARTMENT

State of California
Department of Public Works
Division of Highways
Materials and Research Department

September 1962

W. O. AF10 001-P
Lab. Auth. 72-Q-6283

Mr. E. W. Hampton
Acting State Architect
Division of Architecture
Sacramento, California

Attention: Mr. Aldo Crestetto, Civil Engineer Supervisor

Dear Sir:

Submitted for your consideration is:

A REPORT OF

A PRELIMINARY CORROSION SURVEY

AT THE PROPOSED NORTHERN CALIFORNIA YOUTH CENTER

Study made by . . . . Structural Materials Section
Under general direction of . . . . J. L. Beaton
Work supervised by . . . . R. F. Stratfull
Report prepared by . . . . R. F. Stratfull and W. S. Maxwell
Field work by . . . . W. S. Maxwell and A. F. Andrade

Very truly yours,

F. N. Hveem
Materials and Research Engineer

John L Beaton

By
J. L. Beaton
Supervising Highway Engineer

RFS:mw
cc: OEAnderson
ISchultz

I. INTRODUCTION

On July 6, 1962, Mr. Aldo Crestetto, Civil Engineer Supervisor, Division of Architecture, requested by letter that the Materials and Research Department perform a soil resistivity survey at the proposed site of the Northern California Youth Center located near Stockton, San Joaquin County, California.

It was requested that a corrosion survey be made for the purpose of protecting future underground utility installations from accelerated corrosion at the proposed building site.

Representatives of the Materials and Research Department performed the preliminary corrosion survey on July 24 and 25, 1962, and the results are included in this report.

II. SUMMARY AND CONCLUSIONS

Corrosive soils were found at the proposed site. It is estimated from an empirical corrosion test that a bare 3/4" steel pipe could be perforated by corrosion in the low resistivity soils in approximately five years.

The electrical resistivity of the soils at this site indicates that it is highly corrosive to underground steel pipe; therefore, it is recommended that cathodic protection be applied to any underground steel pipe.

III. RECOMMENDATIONS

1. Wherever economically and mechanically possible, underground pipe and conduit be nonmetallic.

2. That cathodic protection be applied to underground steel pipe at the time of the construction of the facility.

3. All steel pipe placed underground shall be coated in accordance with the Standard Specifications for Mechanical Work, dated 1960, Division of Architecture.

4. All steel pipe placed underground shall be electrically continuous and electrically bonded together by a pipe connection or an AWG number 2 TW Jumper Wire.

5. All underground steel pipe that makes an ingress into any building shall be electrically insulated from any reinforcing steel or other metals within the structure.

6. Where steel pipe enters a building through a riser that is atmospherically exposed, an electrical insulating device shall be placed in the section of pipe that is exposed to the atmosphere. This location will also be prior to the point of entry of the pipe through the building wall or floor.

7. At locations where buried steel pipe enters a building, the following shall apply:

   A. The wall, footing or slab shall contain a nonmetallic pipe sleeve as described in Section 2M, article 2M-22-d of the Standard Specifications for Mechanical Work.

   B. Within six (6) inches of the floor or wall of the structure, an electrical insulating device shall be placed in the pipe. A warning sign in the form of a copper bearing metal tag labeled "Do Not Electrically Bond Across this Fitting" shall be attached to the pipe where the insulating device is installed.

8. No steel pipe which is to be installed beneath concrete slabs shall lie within 12" of the slab or aggregate base material except at locations where the pipe rises to enter a building or other structure.

9. All electrical insulating devices that are installed in underground pipe shall be installed with wires that are attached to the pipe so that performance of the insulator may be checked without excavation, etc.

10. At all underground locations that steel pipes cross, but are not in mechanical contact, a jumper wire shall be installed to electrically bond the pipes.

11. Where steel pipes are placed within 5 feet of each other and are on a parallel alignment, a jumper wire shall be installed every 1,000 feet to electrically connect the pipes.

12. The joints of cast iron pipe shall be so constructed that each length of pipe shall be electrically insulated from its adjacent section.

13. All underground electrical conduit is to be made of non-metallic materials.

14. All underground telephone cables shall be coated with a reinforced neoprene jacket.

15. All underground conduit shall be free-draining so as to remain free of standing water.

16. Calcium chloride or other chloride bearing additives shall not be added to concrete containing reinforcing steel or radiant heating systems in excess of 0.02 pounds per cubic yard.

17. Within 30 days after the contract for construction is let, the contractor shall notify in writing all major utility companies in the area of the State's intentions to cathodically protect the underground pipe.

18. Electrical insulating couplings shall be placed in the piping at the following locations:

    A. At all connections between State piping and those of private utilities.

    B. At all connections of copper to steel pipe.

19. No piping placed in the same excavation shall lie across or otherwise be in mechanical or electrical contact with other pipe except at designated locations.

20. Where mechanically feasible, use a nonmetallic pipe.

21. Do not ground electrical system to underground utility pipe.

22. All electrical ground wires that are within underground conduit shall have a TW coating or equal.

23. All water wells should be electrically connected to the distribution lines and placed under cathodic protection.

IV. TESTS

A. WATER

Water was sampled from four wells to determine the range of chemical composition of the waters that could be used at the facility. The results of a chemical analysis of these water samples are as follows:

TESTS	WELL WATER SAMPLES			
<u>Anions</u>	#3	#6	#7	#8
Chloride (Cl) ppm	24	24	30	24
Sulfates (SO_4) ppm	Nil	14	21	Nil
<u>Determinations</u>				
Total alkalinity as (Ca CO_3) ppm	122	180	194	105
Calcium as (Ca CO_3) ppm	66	102	112	56
Total solids at 105° C ppm	150	250	290	160
(Hydrogen Ion Conc.) pH	8.2	7.9	7.9	8.0
Resistivity (ohm-cm)	3150	2250	2000	3550
<u>Langelier</u>				
Index (pHs)	7.7	7.3	7.3	7.8

From an empirical corrosion test it is estimated that a 3/4" bare steel pipe could be perforated by internal corrosion of the pipe in approximately 35 years.

From calculations based upon the Langelier Index, the well water will tend to deposit scale.

B. SOIL

The soil resistivity measurements of the site are plotted on Exhibit I, Equi-Resistivity Contour Plan. As will be noted on Exhibit I, the soil resistivity taken in the field ranged from 200 ohm-cm to 2700 ohm-cm. The average electrical resistivity of the soil at the site was 834 ohm-cm.

Laboratory tests were performed on soil samples obtained from selected locations throughout the site.

Results of these tests are as follows:

1. The pH varied from 7.0 to 7.4.

2. The minimum soil resistivity varied from 1050 to 2900 ohm-cm and indicates that the surface soils are not as corrosive as those at a greater depth.

Both the field and laboratory resistivity tests indicated that the soil is corrosive to underground steel pipe.

The corrosion tests indicate that a 3/4" bare steel pipe could be perforated by corrosion in approximately 5 years.

Surface soil samples obtained from this site indicated the following test values:

Sample No.	1	2	4	5
Sand Equivalent	6	5	4	3
Resistivity-ohm-cm	1320	2900	1050	1050
pH	7.4	7.0	7.2	7.0
Corrosivity	25	30	15	15

Note: A sand equivalent (S.E.) of 0 represents a clay soil and an S.E. of 100 is clean sand. Corrosivity represents the years to perforation of a 3/4" bare steel pipe.

Based upon over-all test values, it is recommended that backfill soil for underground metal structures shall be a sandy soil in which the tested sand equivalent value shall not be less than 30, the minimum specific electrical resistivity not less than 2000 ohm-cm, and the pH not less than 6.5.

V. CORROSION CONTROL

The cathodic protection of the underground facilities at this site can be accomplished in the following manner:

Phase I

At the completion of the installation of the underground pipe at Northern California Youth Center site, tests should be performed to determine the economics of using impressed or galvanic currents for corrosion control.

Design of the cathodic protection system should be based upon field tests of the existing facilities.

A preliminary cost estimate of the cathodic protection facilities can be made when working drawings are available. However, the actual design of the system will require a field test of the in-place facilities.

Phase II

Install required cathodic protection facilities.

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